university of groningen / faculty of arts

NWO Netherlands Organisation for Scientific Research

UNIVERSITY OF APPLIED SCIENCES UTRECHT

# Computerized assessment of the acoustics of primary progressive aphasia.

Roelant Ossewaarde[1,2], Fedor Jalvingh[1,3] Roel Jonkers[1], and Roelien Bastiaanse[1]

1 Center for Language and Cognition, University of Groningen, r.a.ossewaarde@rug.nl, 2 HU University of Applied Science, Institute for ICT, Utrecht,

3 St. Marienhospital - Vechta, Geriatric Clinic Vechta, Germany

**Introduction** Primary progressive aphasia is caused by fronto-temporal dementia. Subtypes are fluent (fluent but empty speech, comprehension of word meaning is affected / 'semantic dementia') and non-fluent (agrammatism, hesitant or labored speech, word finding problems). Transcription of spontaneous speech can aid detection of PPA but is costly. The use of software can bring down costs, but it is still an open question which software detectable features that are relevant for PPA-diagnosis can be easily obtained with a high degree of certainty.

One measure of the quality of speech is fluency. According to Kormos (2004) and Cucchiarini (2002), speech rate is the best predictor of subjective fluency as perceived by human judges. We studied how to detect fluency differences between PPA-diagnosed subjects and control speakers.

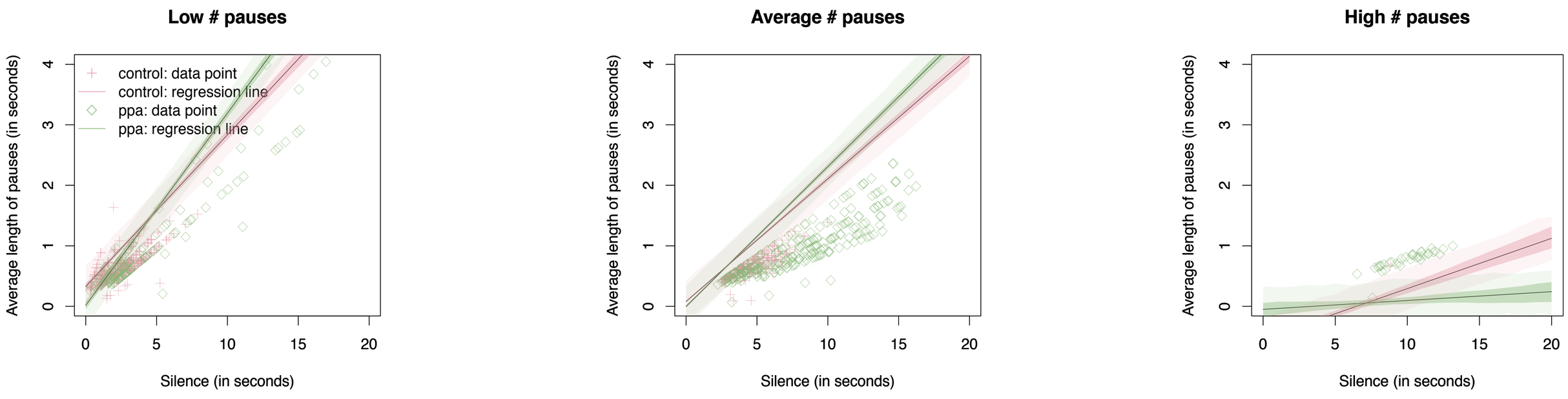


Figure 1: Regression lines fit to data of PPA-patients (red) and controls (green). The line represents the average predicted mean, the shades predict the 95% credible percentile intervals of the mean (darker) and of estimated values (lighter). Each plot is for a different level of pause frequency.

## Methods & participants

Input data are fragments of spontaneous conversations in German: from a group of controls (n=8) and three fragments each from subjects prediagnosed with: Alzheimer's disease (n=9), Parkinson's disease (n=14), PPA (n=3), a behavioral variant of FTD (n=4) and vascular aphasia (n=5). Data was elicited in a larger study currently performed by the second author.

We extracted and detected syllables and pauses using De Jong's (2009) algorithm. We then trained a naive Bayes multilevel probability model to predict number of pauses as a function of silence and length of pauses and their interaction. A Bayesian analysis provides rich and informative inferences even on small sample datasets like ours.

The joint valuation of silence and number of pauses yields a measure for average pause length.

## Results

If PPA patients use few pauses, their pauses are as long as those of controls. But if they use many pauses, the pauses tend to be shorter compared to controls (fig. 1). In a fixed amount of time, this results in more pauses, hence the perception of affected fluency.

In general, PPA patients tend to produce more pauses (fig. 2).

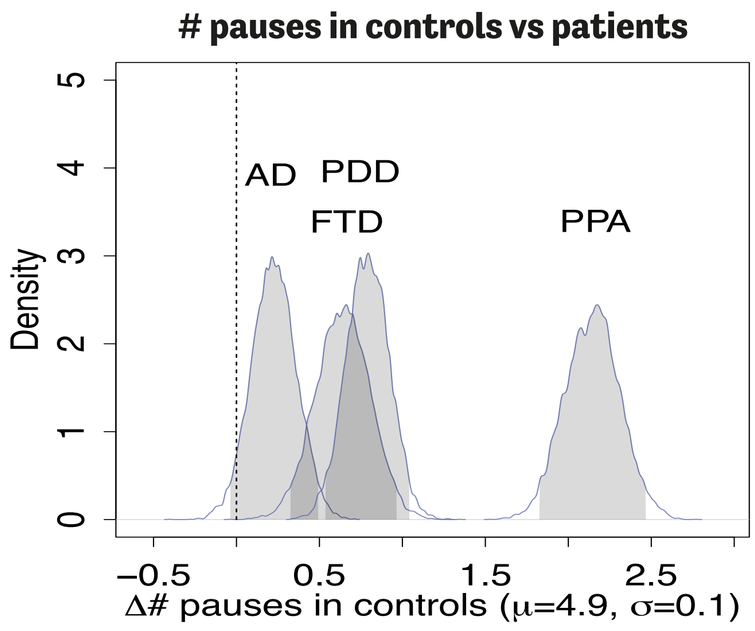


Figure 2 (left): Differences in predicted means of # pauses between controls and patient groups, including their 95% HPDI (shaded); the vertical line indicates the mean of controls. AD = Alzheimer's disease, PDD = Parkinson's disease dementia.

## Conclusion

When evaluating the speech of PPA-patients vs controls, a high number of pauses combined with a weak correlation between number of pauses and amount of silence can be used to distinguish patients from controls. Because PPA-patient tend to use more pauses, this variable can be useful in a classification model.

## References

De Jong & Wempe (2009), *Beh Res Met* 41(2):385.

Kormos (2004), *System* 32:145.

Cucchiarini (2002), *J. Acoust. Soc. Am.* 111:2862.